APPENDIX J

PRELIMINARY ECOLOGICAL RISK ASSESSMENT

Technical Memorandum

Preliminary Ecological Risk Assessment

Ranges West Of Iron Mountain Road

Parcels 73Q-X, 91Q-X, 115Q, 116Q-X, 117Q-X, 129Q-X, 151Q, 191(7), 194(7)/518(7), 200Q, 201Q, 228Q, 229Q-X, 231Q, 232Q-X, Washington Tank Range, and 1950 Rocket Launcher Range

Fort McClellan
Calhoun County, Alabama

This Technical Memorandum presents the Preliminary Ecological Risk Assessment (PERA) for the Ranges West of Iron Mountain Road (RWIMR) at Fort McClellan (FTMC) located in Calhoun County, Alabama. The RWIMR consist of the following ranges: Parcels 73Q-X, 91Q-X, 115Q, 116Q-X, 117Q-X, 129Q-X, 151Q, 191(7), 194(7)/518(7), 200Q, 201Q, 228Q, 229Q-X, 231Q, 232Q-X, Washington Tank Range, and 1950 Rocket Launcher Range. The PERA approach is a shortened version of the Screening-Level Ecological Risk Assessment (SLERA) protocol, which has been developed for FTMC as a means to evaluate numerous sites in a uniform and economical way. It is assumed that the reader is familiar with FTMC and the fundamentals of the SLERA protocol presented in the Installation-Wide Work Plan (IT Corp., 1998). Each step of the PERA is described in the following sections.

Ecological Habitat Description. The Ranges West of Iron Mountain Road (RWIMR) encompasses an area of approximately 750 acres. They are located in the western portion of the Main Post. The east-west limits of the study area are from the western boundary of the Main Post, east to Iron Mountain Road, north of Yahou Lake. The study area for the RWIMR is focused on the areas of the firing lines and the probable impact areas of each range. The elevation within the study area ranges from about 790 feet above mean sea level (amsl) in Parcel 232Q-X, in the northern portion of the study area, to approximately 1,270 feet amsl at the top of Iron Mountain in the east-central portion of the study area. The highest elevation within the study area is a ridge along the western side of Iron Mountain Road. This ridge, which runs primarily north and south, slopes to the west and northwest, and connects Iron Mountain and Wheeler Hill. This ridge appears to have been a backstop to many of the ranges in the area.

Iron Mountain (1,270 feet amsl) and Wheeler Hill (1,260 feet amsl) are the tallest mountains within the east-central and southeastern areas of the RWIMR. Three mountains constitute the southern limit of the RWIMR, including, west to east, Blue Mountain (1,516 feet amsl), Reynolds Hill (1,378 amsl), and Cable Hill (1,240 feet amsl). The perennial and intermittent streams that drain the study area flow to the west, northwest, and to the north.

Due to the large size of the study area, the ecological habitat within the study area is highly variable. The majority of the study area can be classified as mixed deciduous/coniferous forest. There are also portions of the study area that are characteristic of oldfield habitat, cleared land, and maintained lawns. There are also numerous ephemeral drainage features within the study area. It is important to note that the Eastern Bypass right-of-way passes through the study area in a north-south direction. The bypass right-of-way has been clear-cut of all vegetation and construction of the bypass will alter/eliminate the ecological habitat within the right-of-way and surrounding areas.

Within the forested areas, the cover species that are typically found include scrub pine (*Pinus virginiana*), loblolly pine (*Pinus taeda*), white oak (*Quercus alba*), post oak (*Quercus stellata*), chestnut oak (*Quercus prinus*), southern red oak (*Quercus falcata*), wild black cherry (*Prunus serotina*), hackberry (*Celtis occidentalis*), black walnut

(*Juglans nigra*), and flowering dogwood (*Cornus florida*). These mixed deciduous/coniferous forests exhibit sparse, shade-tolerant undergrowth species such as *Parthenocissus quinquefolia* (Virginia creeper), *Polystrichum acrotichoides* (Christmas fern), and *Toxicodendron radicans* (poison ivy). Understory and shrub species are typically sparse in this type of habitat. A mat of pine needles and leaves generally inhibits the growth of shrub and herbaceous layers within this forest type. Typical terrestrial species inhabiting this type of habitat include eastern gray squirrel (*Sciurus carolinensis*), whitetail deer (*Odocoileus virginianus*), wild turkey (*Meleagris gallopavo*), shorttail shrew (*Blarina brevicauda* or *Blarina carolinensis*), red fox (*Vulpes vulpes*), white-footed mouse (*Peromyscus leucopus*), American robin (*Turdus migratorius*), and red-tailed hawk (*Buteo jamaicensis*).

The formerly cleared and maintained areas within the study area are best characterized as oldfield/early successional habitats. Since maintenance activities have ceased in these areas, pioneer species are colonizing these portions of the study area. Typically, the species most likely to colonize these areas are the "weed" species that tend to be vigorous pioneer plants that grow and spread rapidly. The first of the pioneer species to invade these abandoned areas are the grasses and herbaceous species. These formerly maintained grassy areas are classified as being in an early oldfield successional state. Over time, these grass and herbaceous species will be followed by shrubs and small trees. The oldfield, early successional habitat within the study area of the RWIMR is dominated by various grasses and herbs including *Rumex spp.* (dock), *Trifolium spp.* (clover), *Astragalus spp.* (vetch), *Ascelepias spp.* (milkweed), *Galium spp.* (bed straw), *Chrysanthemum leucanthemum* (ox-eye daisy), and *Sorghum halepense* (Johnson grass). Other oldfield herbaceous species occurring within the RWIMR study area include *Rubus occidentalis* (black raspberry), *Toxicodendron radicans* (poison ivy), *Rubus glabra* (smooth sumac), *Smilax rotundiflora* (green brier), *Lonicera japonica* (Japanese honeysuckle), *Vitus labrusca* (fox grape), and *Rosa multiflora* (multiflora rose). Loblolly pine (*Pinus taeda)* and shortleaf pine (*Pinus echinata*) saplings have also begun to encroach into this oldfield, early successional habitat.

Typical terrestrial species inhabiting the oldfield, early successional habitat include Eastern cottontail (*Sylvilagus floridanus*), whitetail deer (*Odocoileus virginianus*), wild turkey (*Meleagris gallopavo*), shorttail shrew (*Blarina brevicauda* or *Blarina carolinensis*), red fox (*Vulpes vulpes*), white-footed mouse (*Peromyscus leucopus*), American robin (*Turdus migratorius*), and red-tailed hawk (*Buteo jamaicensis*).

As stated previously, the Eastern Bypass right-of-way passes through the RWIMR study area and encompasses a large percentage of the total study area. The habitat within the right-of-way has been effectively eliminated by clear-cutting all of the vegetation. Construction activities within the right-of-way will further alter the ecological habitat within the right-of-way and the areas directly adjacent to it.

Numerous small, ephemeral streams drain the study area to the west, northwest, and to the north. These drainage features can be generally characterized as narrow (less than 3 feet wide), shallow (less than 6 inches deep) with substrates of cobbles and gravel with

isolated areas of sand and leaf litter. Because these drainage features are ephemeral in nature, they only exhibit flowing water during periods of significant precipitation. As such, they are dry during significant portions of most years. Due to their ephemeral nature, larger aquatic species (e.g. carnivorous fish and piscivores) are not likely to utilize these streams for habitat. Smaller drought-tolerant fish species and semi-aquatic species (e.g. amphibians) may utilize these ephemeral streams during periods of significant precipitation.

Media of Interest and Data Selection. The media of interest at the RWIMR are surface soil, surface water, sediment, and groundwater. Terrestrial species could be exposed to surface soil via a number of pathways during routine feeding, grooming, and nesting habits. Terrestrial and semi-aquatic species could be exposed to surface water and/or sediment via surface water consumption and other routine feeding activities. Semi-aquatic species could be exposed to groundwater via groundwater intrusion to surface water bodies (e.g. ephemeral streams) and subsequent surface water exposure pathways. One hundred and one surface and depositional soil samples were collected and analyzed for metals, explosives, and perchlorate. Six of the 101 samples were also analyzed for semi-volatile organic compounds (SVOC) and volatile organic compounds (VOC). Certain compounds, such as 2,4-dinitrotoluene, were analyzed by two methods (explosives and SVOCs). Eighteen surface water and sediment samples were collected and analyzed for metals, explosives, and perchlorate. Fifty-two groundwater samples were collected and analyzed for metals, VOCs, explosives, and perchlorate. Four of those 52 samples were also collected for SVOCs. Ten additional groundwater samples were collected for either selected explosives or selected metals or both.

Identification of Constituents of Potential Ecological Concern. In order to determine whether constituents detected in environmental samples collected at the RWIMR have the potential to pose adverse ecological risks, screening-level hazard quotients were developed. The screening-level hazard quotients were developed via a three-step process as follows:

- Comparison to Ecological Screening Values (ESVs);
- Identification of essential macro-nutrients; and
- Comparison to naturally-occurring background concentrations.

The ecological screening values (ESV) used in this assessment represent the most conservative values available from various literature sources and have been selected to be protective of the most sensitive ecological assessment endpoints. These ESVs have been developed specifically for FTMC in conjunction with USEPA Region IV and are presented in the *Final Human Health and Ecological Screening Values and PAH Background Summary Report* (IT, 2000). The ESVs used in this assessment are based on no-observed-adverse-effect-levels (NOAEL) when available. If a NOAEL-based ESV was not available for a certain constituent, then the most health-protective value available from the scientific literature was used in this assessment.

Constituents that were detected in surface soil, surface water, sediment, and groundwater at the RWIMR were evaluated against the ESVs by calculating a screening-level hazard quotient (HQ_{screen}) for each constituent. An HQ_{screen} was calculated by dividing the maximum detected constituent concentration in each environmental medium by its corresponding ESV as follows:

$$HQ_{screen} = \frac{MDCC}{ESV}$$

where:

HQ_{screen}	=	screening-level hazard quotient;
$MDCC$	=	maximum detected constituent concentration; and
ESV	=	ecological screening value.

A calculated HQ_{screen} value of one indicated that the MDCC was equal to the chemical's conservative ESV and was interpreted in this assessment as a constituent that does not pose the potential for adverse ecological risk. A HQ_{screen} value less than one indicated that the MDCC was less than the conservative ESV, and that the chemical is not likely to pose adverse ecological hazards to most receptors. Conversely, a HQ_{screen} value greater than one indicated that the MDCC was greater than the ESV and that the chemical might pose adverse ecological hazards to one or more receptors.

In order to better understand the potential risks posed by chemical constituents at the RWIMR, a mean hazard quotient was also calculated by comparing the arithmetic mean constituent concentrations in each environmental medium to the corresponding ESVs. The calculated screening-level hazard quotients for surface soil, surface water, sediment, and groundwater at the RWIMR are presented in Tables 1 through 4.

The USEPA recognizes several constituents in abiotic media that are necessary to maintain normal function in many organisms. These essential macro-nutrients are iron, magnesium, calcium, potassium, and sodium (USEPA, 1989). Most organisms have mechanisms designed to regulate nutrient fluxes within their systems; therefore, these nutrients are generally only toxic at very high concentrations. Although iron is an essential nutrient and is regulated within many organisms, it may become increasingly bioavailable at lower pH values, thus increasing its potential to elicit adverse affects. Therefore, iron was not evaluated as an essential nutrient in this PERA. Essential macro-nutrients were only considered COPECs if they were present in site samples at concentrations ten times the naturally-occurring background concentration.

The comparison of detected constituent concentrations with naturally occurring constituent concentrations was conducted via a three-tier process outlined in a technical memorandum dated April 28, 2003 (Shaw, 2003). The first tier of the background comparison process was a comparison of the maximum detected constituent concentration to the background threshold value (BTV). A study of the natural geochemical composition associated with FTMC (SAIC, 1998) determined the mean

concentrations of 24 metals in surface soil, surface water, sediment, and groundwater samples collected from presumably un-impacted areas. Per agreement with USEPA Region IV, the background threshold value (BTV) for each metal was calculated as two times the mean background concentration for that metal. The BTV for each metal was used to represent the upper boundary of the range of natural background concentrations expected at FTMC, and was used as the basis for evaluating metal concentrations measured in site samples. Site sample metal concentrations less than or equal to the corresponding BTV represent the natural geochemical composition of media at FTMC, and not contamination associated with site activity. Site sample metal concentrations greater than the corresponding BTV require further background assessment.

If maximum constituent concentrations were greater than the BTV, then the second tier of the background comparison was employed. Tier two of the background comparison consists of statistical comparisons of the site data to background data using the Slippage Test and the Wilcoxon Rank Sum (WRS) Test. If the site data failed either the Slippage Test or the WRS Test, then the site data were subjected to a geochemical evaluation (Tier 3) to determine whether concentrations of inorganic compounds are naturally occurring or are elevated due to contamination.

Thus, the first step in determining screening-level hazard quotients was a comparison of maximum detected constituent concentrations to appropriate ESVs. Constituents with HQ_{screen} values less than one were considered to pose insignificant ecological risk and were eliminated from further consideration. Constituents with HQ_{screen} values greater than one were eliminated from further consideration if they were macro-nutrients. Those constituents that had HQ_{screen} values greater one and were not considered macro-nutrients were then compared to background using the three-tier background screening process. If constituent concentrations were determined to be less than their naturally-occurring background concentrations, then a risk management decision could result in eliminating these constituents from further assessment.

The constituents in surface soil that exceeded their respective ESVs, were not essential macro-nutrients, and were detected at concentrations greater than naturally-occurring levels are the following:

- p-cymene;
- pentachlorophenol; and
- cadmium

The constituent in surface water that exceeded it's respective ESV, was not an essential macro-nutrient, and was detected at a concentration greater than naturally-occurring levels is the following:

- perchlorate

None of the constituents detected in sediment were identified as COPECs.

Groundwater at the RWIMR was assessed using surface water ESVs in order to determine the potential for impacts to aquatic organisms from groundwater intrusion to the ephemeral drainage features at the RWIMR. It is important to note that surface water ESVs are not intended to be applied to groundwater data because ecological receptors are not directly exposed to groundwater under most circumstances. However, in order to address the potential for future groundwater intrusion into these ephemeral drainage features, the groundwater-to-surface water ESV comparison was incorporated into this PERA. Current conditions in the ephemeral drainage features at the RWIMR are most appropriately assessed via a comparison of surface water data from the drainage features to surface water ESVs. The constituents in groundwater that exceeded their respective surface water ESVs, were not essential macro-nutrients, and were detected at concentrations greater than naturally-occurring levels are the following:

- p-cymene
- 2-nitrotoluene
- 3-nitrotoluene
- 4-amino-2,6-dinitrotoluene
- p-nitrotoluene
- tetryl
- perchlorate
- beryllium

Additional lines of evidence are sometimes useful in determining whether a certain constituent is in fact site-related and a COPEC. Some of the additional lines of evidence used in the process of identifying COPECs include: 1) frequency of detection, 2) magnitude of the HQ_{screen} value, 3) spatial distribution, 4) alternative ESVs; and 5) association of a chemical with known Army activities. These additional lines-of-evidence were used to further define the COPECs at the RWIMR.

Surface Soil COPECs

Two semi-volatile organic compounds (pentachlorophenol and pyrene) were detected in one out of six surface soil samples at concentrations that exceeded their respective ESVs. The detected concentration of pyrene was less than the background concentration for pyrene in soil (1.656 mg/kg) located adjacent to asphalt (IT, 2000), indicating the detected pyrene may be indicative of background conditions at FTMC. Although no similar background concentration for pentachlorophenol has been determined, it is likely that the background concentration of pentachlorophenol adjacent to asphalt would be greater than the detected concentration in surface soil at the RWIMR based on background concentrations of other PAHs adjacent to asphalt (IT, 2000). Based on the relative infrequency of detection of these PAH compounds and fact that they were detected at concentrations less than background concentrations, these PAHs should not be considered COPECs at the RWIMR.

The volatile organic compound p-cymene was detected in one out of six surface soil samples. Because there is no surface soil ESV for p-cymene, definitive statements regarding its potential toxicity can not be made. However, the detected concentration of

p-cymene is significantly less than the ESV for other volatile organic compounds detected in surface soil at the RWIMR. Therefore, based on the infrequency of detection and the fact that the detected concentration is less than the ESV for similar compounds, p-cymene was not considered a COPEC in surface soil at the RWIMR.

Cadmium was detected in one sample out of 101 at a concentration that exceeded the ESV. The calculated HQ_{screen} value was 2.7, indicating the maximum detected concentration of cadmium in surface soil only slightly exceeded the ESV. An alternative ESV that could be considered for cadmium in soil is 20 mg/kg, and is based on the protection of terrestrial invertebrates (Efroymson, et al., 1997). Based on the infrequency of detection, the low magnitude of the calculated HQ_{screen} value, and the detected concentrations relative to an alternative ESV, cadmium was not considered a COPEC in surface soil at the RWIMR.

Surface Water COPECs

Perchlorate was detected in one surface water sample out of 18, albeit at an estimated concentration less than the reporting level. Because there is no applicable ESV or BTV for perchlorate in surface water, it is not possible to make definitive statements regarding its potential toxicity; however, because it was detected infrequently, and the detected concentration was less than the concentration that would cause adverse ecological impact for similar chemicals, perchlorate was not considered a COPEC in surface water at the RWIMR.

Sediment COPECs

None of the constituents detected in sediment associated with the RWIMR were identified as COPECs.

Groundwater COPECs

Several organic compounds were detected in groundwater at the RWIMR at concentrations that have the potential to pose adverse ecological risk. P-cymene was detected in one groundwater sample out of 52, but because there is no applicable ESV or BTV for p-cymene, it is not possible to make definitive statements regarding its potential toxicity. Due to the infrequency of detection and the low detected concentration relative to the ESVs for other volatile organic compounds, p-cymene was not considered a COPEC in groundwater at the RWIMR. Perchlorate was detected in five groundwater samples out of 52, albeit at estimated concentrations less than the reporting level. Because there is no applicable ESV or BTV for perchlorate, it is not possible to make definitive statements regarding its potential toxicity; however, because it was detected infrequently, and the detected concentrations were less than the concentration that would cause adverse ecological impact for similar chemicals, perchlorate was not considered a COPEC in groundwater at the RWIMR. 2-Nitrotoluene, 3-nitrotoluene, 4-amino-2,6-dinitrotoluene, p-nitrotoluene, and tetryl were detected in several groundwater samples, but because there are no applicable ESVs or BTVs for these compounds, it is not possible to make definitive statements regarding their potential toxicity. However, the detected concentrations of these compounds are less than the ESVs for other similar nitro-aromatic compounds. Therefore, based on the relative infrequency of detection and the low

detected concentrations relative to the ESVs for other nitro-aromatic compounds, 2-nitrotoluene, 3-nitrotoluene, 4-amino-2,6-dinitrotoluene, p-nitrotoluene, and tetryl were not considered COPECs in groundwater at the RWIMR. Additionally, none of these organic compounds that were detected in groundwater samples from the RWIMR were detected in surface water samples.

Beryllium was detected in two groundwater samples out of 52 at concentrations that exceeded the BTV. There was no apparent pattern to the elevated concentrations of beryllium in groundwater. All of the groundwater samples except one exhibited beryllium concentrations that were within the range of background. Due to the relative infrequency of detection and the fact that all of the beryllium detections except one were within the range of background, beryllium was not considered a COPEC in groundwater at the RWIMR.

Ecological Risk Characterization. P-cymene was detected in one out of six surface soil samples and was initially identified as a COPEC because there is no appropriate ESV. However, based on the infrequency of detection and the fact that the detected concentration was less than the ESV for similar compounds, p-cymene was not considered a COPEC in surface soil at the RWIMR. Pentachlorophenol was also initially identified as a COPEC in surface soil. However, based on the infrequency of detection and the fact that the detected concentration is less than background concentrations for other similar PAH compounds, pentachlorophenol was not considered a COPEC in surface soil at the RWIMR. Cadmium was detected in one sample out of 101 at a concentration that exceeded the ESV. Based on the infrequency of detection, the low magnitude of the calculated HQ_{screen} value, and the detected concentrations relative to an alternative ESV, cadmium was not considered a COPEC in surface soil at the RWIMR. Therefore, using the COPEC identification process and additional lines-of-evidence, none of the constituents detected in surface soil at the RWIMR were considered COPECs.

Perchlorate was detected in one surface water sample, albeit at a very low concentration. It was initially identified as a COPEC because there is no appropriate ESV. Due to the low detection frequency and the detected concentration relative to ESVs for similar compounds perchlorate was not considered a COPEC in surface water at the RWIMR. Therefore, using the COPEC identification process and additional lines-of-evidence, none of the constituents detected in surface water at the RWIMR were considered COPECs.

None of the constituents detected in sediment were considered COPECs at the RWIMR.

Several nitro-aromatic compounds, perchlorate, and p-cymene were detected in groundwater at very low concentrations. They were initially identified as COPECs due to the fact that there are no ESVs associated with them. None of these organic constituents were detected in surface water samples associated with the RWIMR, indicating the groundwater-surface water exchange is insignificant at the RWIMR. Due to their low concentrations and infrequency of detection, they were not considered COPECs in groundwater at the RWIMR. Beryllium was initially identified as COPEC in groundwater at the RWIMR. However, beryllium was infrequently detected (one sample

out of 52 exceeded the BTV) and was detected at low concentrations; therefore, it was not considered a COPEC in groundwater at the RWIMR. Therefore, using the COPEC identification process and additional lines-of-evidence, none of the constituents detected in groundwater at the RWIMR were identified as COPECs.

Based on this assessment, none of the constituents detected in surface soil, surface water, sediment, or groundwater have the potential to pose adverse ecological risk at the RWIMR.

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TABLE 1
CONSTITUENTS OF POTENTIAL ECOLOGICAL CONCERN IN SURFACE SOIL
Ranges West Of Iron Mountain Road
Fort McClellan, Calhoun County, Alabama

Detected Constituents	Background Threshold Value[a] (mg/kg)	Ecological Screening Value[b] (mg/kg)	Frequency of Detection	Maximum Detected Concentration (mg/kg)	Minimum Detected Concentration (mg/kg)	Mean Detected Concentration (mg/kg)	Maximum Hazard Quotient	Mean Hazard Quotient	Constituent of Potential Ecological Concern
Volatiles :									
2-Butanone	NA	89.6	1 of 6	0.012	0.012	0.010	0.00013	0.00012	1
Acetone	NA	2.5	6 of 6	0.39	0.055	0.19	0.156	0.0767	1
Methylene Chloride	NA	2	1 of 1	0.0012	0.0012	0.001	0.0006	0.0006	1
p-Cymene	NA	NA	1 of 6	0.0028	0.0028	0.0028	ND	ND	6
Nitroaromatics :									
2,4-Dinitrotoluene	NA	1.28	1 of 107	0.22	0.22	0.20	0.172	0.156	1
Semivolatiles :									
Pentachlorophenol	NA	0.002	1 of 6	0.485	0.25	0.44	242.5	217.9	**YES** [7]
Pyrene	1.626	0.1	1 of 6	0.37	0.37	0.22	3.70	2.18	3
Metals :									
Aluminum	16,300	50	101 of 101	26,600	1,180	9,394	532.0	187.9	5
Antimony	1.99	3.5	6 of 100	5.57	4.74	5.91	1.59	1.69	4,5
Arsenic	13.7	10	96 of 97	29.1	0.293	3.8	2.91	0.38	4,5
Barium	124	165	101 of 101	263	1.39	58	1.59	0.35	4
Beryllium	0.8	1.1	99 of 100	2.04	0.0125	0.48	1.85	0.44	5
Cadmium	0.29	1.6	1 of 101	4.37	0.5	0.3	2.73	0.21	**YES** [7]
Calcium	1,720	NA	101 of 101	9,120	22.7	407	ND	ND	2,4
Chromium	37	0.4	99 of 99	55.8	1.62	12.9	139.50	32.33	4
Cobalt	15.2	20	73 of 83	36	0.445	6	1.80	0.32	4
Copper	12.7	40	99 of 101	61.4	1.07	6.8	1.54	0.17	4
Iron	34,200	200	101 of 101	70,100	1,780	12829	350.50	64.14	4,5
Lead	40.1	50	101 of 101	3,180	0.656	50	63.60	1.01	4
Magnesium	1,030	440,000	101 of 101	5,290	22.4	436	0.012	0.001	1,2,5
Manganese	1,580	100	101 of 101	4,110	2.5	454	41.10	4.54	4
Mercury	0.08	0.1	65 of 99	0.167	0.024	0.051	1.67	0.51	5
Nickel	10.3	30	92 of 100	39.7	1.09	5.9	1.32	0.20	4
Potassium	800	NA	43 of 70	2,070	127	387	ND	ND	2,5
Selenium	0.48	0.81	5 of 98	0.652	0.47	0.60	0.80	0.74	1
Sodium	634	NA	14 of 101	71	23.4	55.5	ND	ND	2,3
Thallium	3.43	1	14 of 101	3.48	0.627	1.20	3.48	1.20	5

TABLE 1
CONSTITUENTS OF POTENTIAL ECOLOGICAL CONCERN IN SURFACE SOIL
Ranges West Of Iron Mountain Road
Fort McClellan, Calhoun County, Alabama

Detected Constituents	Background Threshold Value[a] (mg/kg)	Ecological Screening Value[b] (mg/kg)	Frequency of Detection	Maximum Detected Concentration (mg/kg)	Minimum Detected Concentration (mg/kg)	Mean Detected Concentration (mg/kg)	Maximum Hazard Quotient	Mean Hazard Quotient	Constituent of Potential Ecological Concern
Vanadium	58.8	2	101 of 101	44.3	3.91	17.8	22.15	8.90	3
Zinc	40.6	50	101 of 101	108	0.514	22.0	2.16	0.44	5

[a] Background threshold value is two times (2x) the arithmetic mean of background metals (SAIC, 1998). For SVOCs, the BTV is the background screening value for soils adjacent to asphalt as given in IT Corporation (IT), 2000, *Final Human Health and Ecological Screening Values and PAH Background Summary Report, Fort McClellan, Calhoun County, Alabama*, July.

[b] Ecological Screening Values (ESV) are presented in *Human Health and Ecological Screening Values and PAH Background Summary Report* (IT, 2000).

NA - Not available. ND - Not determined.

Rationale for inclusion / exclusion as a COPEC:

1 - Maximum detected concentration is less than ESV
2 - Essential macro-nutrient, only toxic at extremely high concentrations (i.e. 10-times naturally-occurring background concentrations).
3 - Maximum detected concentration is less than the background threshold value (BTV).
4 - Slippage Test and Wilcoxon Rank Sum Test indicate the concentration of this constituent is statistically similar to background concentrations.
5 - Geochemical evaluation of the data indicate that this constituent is naturally occurring.
6 - No ESV available; however, maximum detected concentration of this constituent is less than ESV for similar compounds.
7 - Additional lines of evidence indicate that this constituent may not be a COPEC (see text).

TABLE 2
CONSTITUENTS OF POTENTIAL ECOLOGICAL CONCERN IN SURFACE WATER
Ranges West Of Iron Mountain Road
Fort McClellan, Calhoun County, Alabama

Detected Constituents	Background Threshold Value[a] (mg/L)	Ecological Screening Value[b] (mg/L)	Frequency of Detection	Maximum Detected Concentration (mg/L)	Minimum Detected Concentration (mg/L)	Mean Detected Concentration (mg/L)	Maximum Hazard Quotient	Mean Hazard Quotient	Constituent of Potential Ecological Concern
Perchlorate :									
Perchlorate	NA	NA	1 of 18	0.00266	0.00266	0.00251	ND	ND	6
Metals :									
Aluminum	5.26	0.087	13 of 13	9.71	0.0589	1.16	111.6	13.3	4
Arsenic	0.00217	0.19	2 of 18	0.00545	0.00243	0.00488	0.029	0.026	1,5
Barium	0.0754	0.0039	18 of 18	0.0624	0.0143	0.0268	16.0	6.87	3
Calcium	25.2	116	14 of 14	9.21	0.52	2.45	0.079	0.021	1,2,3
Chromium	0.0111	0.011	1 of 18	0.0058	0.0058	0.0050	0.527	0.459	1,3
Copper	0.0127	0.00654	3 of 17	0.01	0.00318	0.01	1.53	1.36	3
Iron	19.6	1	17 of 18	11.6	0.0398	0.9	11.6	0.924	3
Lead	0.00867	0.00132	3 of 16	0.018	0.00152	0.005	13.64	4.15	4
Magnesium	11	82	18 of 18	5.29	0.457	1.08	0.065	0.013	1,2,3
Manganese	0.565	0.08	18 of 18	0.212	0.00229	0.039	2.65	0.483	3
Nickel	0.0225	0.0877	1 of 18	0.0115	0.0115	0.0101	0.131	0.115	1,3
Selenium	NA	0.005	2 of 18	0.005	0.0024	0.005	1.0	0.952	1,4
Sodium	3.44	680	18 of 18	1.73	0.621	0.89	0.0025	0.0013	1,2,3
Vanadium	0.0152	0.019	1 of 18	0.0165	0.01	0.01	0.868	0.297	1,4
Zinc	0.0404	0.0589	4 of 14	0.0122	0.00645	0.010	0.207	0.164	1,3

[a] Background threshold value is two times (2x) the arithmetic mean of background metals (SAIC, 1998).

[b] Ecological Screening Values (ESV) are presented in *Human Health and Ecological Screening Values and PAH Background Summary Report* (IT, 2000).

NA - Not available. ND - Not determined.

Rationale for inclusion / exclusion as a COPEC:

1 - Maximum detected concentration is less than ESV

2 - Essential macro-nutrient, only toxic at extremely high concentrations (i.e. 10-times naturally-occurring background concentrations).

3 - Maximum detected concentration is less than the background threshold value (BTV).

4 - Slippage Test and Wilcoxon Rank Sum Test indicate the concentration of this constituent is statistically similar to background concentrations.

5 - Geochemical evaluation of the data indicate that this constituent is naturally occurring.

6 - No ESV available; however, maximum detected concentration of this constituent is less than ESV for similar compounds.

TABLE 3
CONSTITUENTS OF POTENTIAL ECOLOGICAL CONCERN IN SEDIMENT
Ranges West Of Iron Mountain Road
Fort McClellan, Calhoun County, Alabama

Detected Constituents	Background Threshold Value[a] (mg/kg)	Ecological Screening Value[b] (mg/kg)	Frequency of Detection	Maximum Detected Concentration (mg/kg)	Minimum Detected Concentration (mg/kg)	Mean Detected Concentration (mg/kg)	Maximum Hazard Quotient	Mean Hazard Quotient	Constituent of Potential Ecological Concern
Metals :									
Aluminum	8,590	NA	18 of 18	11,100	3,050	6742	ND	ND	5
Arsenic	11.3	7.24	18 of 18	10.6	0.863	3.4	1.46409	0.46947	3
Barium	98.9	NA	18 of 18	112	9.38	49	ND	ND	4
Beryllium	0.97	NA	18 of 18	1.18	0.126	0.45	ND	ND	4
Cadmium	0.43	1	2 of 18	0.882	0.609	0.397	0.88200	0.39694	1,5
Calcium	1,110	NA	18 of 18	1,570	61.7	423	ND	ND	2,4
Chromium	31.2	52.3	18 of 18	56.3	3.21	14.0	1.07648	0.26828	4
Cobalt	11	50	12 of 13	14.7	0.903	4.0	0.29400	0.07943	1,4
Copper	17.1	18.7	17 of 18	44.8	1.07	7.9	2.39572	0.42181	4
Iron	35,300	NA	18 of 18	39,200	3,000	12164	ND	ND	4
Lead	37.8	30.2	18 of 18	61.4	2.81	14.8	2.03311	0.49134	4
Magnesium	906	NA	18 of 18	1,800	112	367	ND	ND	2,4
Manganese	712	NA	18 of 18	1,270	41	263.83	ND	ND	4
Mercury	0.11	0.13	10 of 18	0.181	0.038	0.07	1.39231	0.56560	5
Nickel	13	15.9	16 of 18	24.1	1.72	4.9	1.51572	0.30774	4
Potassium	1,010	NA	4 of 12	675	146	409	ND	ND	2,3
Sodium	692	NA	8 of 18	90	26.6	55	ND	ND	2,3
Vanadium	40.9	NA	18 of 18	63	5.15	18	ND	ND	4
Zinc	52.7	124	18 of 18	126	4.31	26	1.01613	0.20629	4

[a] Background threshold value is two times (2x) the arithmetic mean of background metals (SAIC, 1998).

[b] Ecological Screening Values (ESV) are presented in *Human Health and Ecological Screening Values and PAH Background Summary Report* (IT, 2000).

NA - Not available. ND - Not determined.

Rationale for inclusion / exclusion as a COPEC:

1 - Maximum detected concentration is less than ESV

2 - Essential macro-nutrient, only toxic at extremely high concentrations (i.e. 10-times naturally-occurring background concentrations).

3 - Maximum detected concentration is less than the background threshold value (BTV).

4 - Slippage Test and Wilcoxon Rank Sum Test indicate the concentration of this constituent is statistically similar to background concentrations.

5 - Geochemical evaluation of the data indicate that this constituent is naturally occurring.

6 - No ESV available; however, maximum detected concentration of this constituent is less than ESV for similar compounds.

TABLE 4
CONSTITUENTS OF POTENTIAL ECOLOGICAL CONCERN IN GROUNDWATER
Ranges West Of Iron Mountain Road
Fort McClellan, Calhoun County, Alabama

Detected Constituents	Background Threshold Value[a] (mg/L)	Ecological Screening Value[b] (mg/L)	Frequency of Detection	Maximum Detected Concentration (mg/L)	Minimum Detected Concentration (mg/L)	Mean Detected Concentration (mg/L)	Maximum Hazard Quotient	Mean Hazard Quotient	Constituent of Potential Ecological Concern
Volatiles :									
Acetone	NA	78	1 of 26	0.82	0.005	0.04	0.01051	0.00053	1
Benzene	NA	0.053	1 of 52	0.0025	0.00083	0.0024	0.04717	0.04439	1
Chloroform	NA	0.289	2 of 52	0.0042	0.001	0.002	0.01453	0.00826	1
Chloromethane	NA	5.5	1 of 52	0.0025	0.0014	0.0024	0.00045	0.00044	1
Methylene chloride	NA	1.93	3 of 50	0.0038	0.001	0.002	0.00197	0.00125	1
p-Cymene	NA	NA	1 of 52	0.0025	0.001	0.002	ND	ND	6
Toluene	NA	0.175	3 of 52	0.0025	0.001	0.002	0.01429	0.01327	1
Trichloroethene	NA	21.9	2 of 52	0.0025	0.001	0.002	0.00011	0.00011	1
Nitroaromatics :									
1,3,5-Trinitrobenzene	NA	0.011	2 of 58	0.0014	0.0002	0.0002	0.12727	0.02030	1
2,4,6-Trinitrotoluene	NA	0.09	1 of 58	0.0002	0.000092	0.0002	0.00222	0.00216	1
2,4-Dinitrotoluene	NA	0.23	1 of 62	0.0048	0.000072	0.0005	0.02087	0.00218	1
2,6-Dinitrotoluene	NA	0.042	1 of 62	0.0048	0.00017	0.0005	0.11429	0.01205	1
2-Nitrotoluene	NA	NA	10 of 58	0.0057	0.0002	0.0004	ND	ND	6
3-Nitrotoluene	NA	NA	4 of 58	0.0017	0.0002	0.0003	ND	ND	6
4-Amino-2,6-dinitrotoluene	NA	NA	3 of 58	0.0018	0.0002	0.0002	ND	ND	6
p-Nitrotoluene	NA	NA	4 of 58	0.0029	0.0002	0.0003	ND	ND	6
Tetryl	NA	NA	2 of 58	0.00036	0.0002	0.0002	ND	ND	6
Perchlorate :									
Perchlorate	NA	NA	5 of 52	0.00255	0.00122	0.00242	ND	ND	6
Metals :									
Aluminum	2.34	0.087	40 of 41	3.71	0.0421	0.59	42.64	6.75	4
Antimony	0.00319	0.16	3 of 61	0.05	0.0284	0.05	0.313	0.303	1,5
Arsenic	0.0178	0.19	3 of 51	0.005	0.00248	0.005	0.026	0.026	1,3
Barium	0.127	0.0039	46 of 46	0.178	0.00377	0.033	45.64	8.39	4
Beryllium	0.00125	0.00053	3 of 52	0.00512	0.00081	0.00074	9.66	1.40	**YES** [7]
Calcium	56.5	116	31 of 32	85.8	0.118	14.6	0.740	0.126	1,2,4
Chromium	NA	0.011	3 of 52	0.0192	0.00496	0.0055	1.745	0.497	5
Cobalt	0.0234	0.003	10 of 49	0.037	0.0049	0.011	12.33	3.59	4
Copper	0.0255	0.00654	3 of 44	0.017	0.00271	0.010	2.60	1.56	3
Iron	7.04	1	47 of 48	9.36	0.0114	1.06	9.36	1.06	4
Lead	0.008	0.00132	3 of 50	0.00964	0.00152	0.00488	7.30	3.70	4

TABLE 4
CONSTITUENTS OF POTENTIAL ECOLOGICAL CONCERN IN GROUNDWATER
Ranges West Of Iron Mountain Road
Fort McClellan, Calhoun County, Alabama

Detected Constituents	Background Threshold Value[a] (mg/L)	Ecological Screening Value[b] (mg/L)	Frequency of Detection	Maximum Detected Concentration (mg/L)	Minimum Detected Concentration (mg/L)	Mean Detected Concentration (mg/L)	Maximum Hazard Quotient	Mean Hazard Quotient	Constituent of Potential Ecological Concern
Magnesium	21.3	82	31 of 31	16.4	0.0825	3.8	0.200	0.046	1,2,3
Manganese	0.581	0.08	50 of 50	1.98	0.00521	0.18	24.75	2.30	4
Mercury	NA	0.000012	1 of 52	0.0005	0.0005	0.0002	41.67	20.73	4
Nickel	NA	0.0877	6 of 38	0.0408	0.0034	0.011633947	0.465	0.133	1,3,5
Potassium	7.2	53	13 of 51	9.72	0.398	2.69	0.183	0.051	1,2,3,4
Selenium	NA	0.005	5 of 45	0.005	0.00177	0.005	1.0	0.902	1,4
Silver	0.0008	0.000012	1 of 48	0.00764	0.00764	0.00506	636.7	421.3	4
Sodium	14.8	680	49 of 50	9.9	0.542	1.9	0.0146	0.0028	1,2,3
Thallium	0.00146	0.004	1 of 51	0.005	0.0048	0.0050	1.25	1.25	4
Vanadium	0.017	0.019	7 of 49	0.0258	0.00386	0.0067	1.36	0.351	4
Zinc	0.22	0.0589	17 of 35	0.198	0.0058	0.021	3.36	0.363	3

[a] Background threshold value is two times (2x) the arithmetic mean of background metals (SAIC, 1998).

[b] Ecological Screening Values (ESV) are presented in *Human Health and Ecological Screening Values and PAH Background Summary Report* (IT, 2000).

NA - Not available. ND - Not determined.

Rationale for inclusion / exclusion as a COPEC:

1 - Maximum detected concentration is less than ESV

2 - Essential macro-nutrient, only toxic at extremely high concentrations (i.e. 10-times naturally-occurring background concentrations).

3 - Maximum detected concentration is less than the background threshold value (BTV).

4 - Slippage Test and Wilcoxon Rank Sum Test indicate the concentration of this constituent is statistically similar to background concentrations.

5 - Geochemical evaluation of the data indicate that this constituent is naturally occurring.

6 - No ESV available; however, maximum detected concentration of this constituent is less than ESV for similar compounds.

7 - Additional lines of evidence indicate that this constituent may not be a COPEC (see text).